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BRIEF COMMUNICATION

THE RESPONSE OF SOIL NEMATODES TO ENVIRONMENTAL STIMULII IN ARID SOUTH AUSTRALIA

Nematodes are known to form an anhydrobiotic coiled state in response to desiccation in soil[1]. From investigation of nematodes occurring in arid areas (Mojave Desert, Nevada, U.S.A.[2]) the anhydrobiotic state was also found to be represented by "coiling". The activity of nematodes can then be related to form, with "coiled" nematodes being inactive or anhydrobiotic and "straight" nematodes being active. A preliminary study was set up to investigate if "coiling" was a good indicator of nematode activity within arid soils. Also under investigation was the overall effect of environmental stimulii on the different nematode trophic groups.

A site located on Plumbago Station pastoral property (near Yunta, South Australia) was selected for sampling. The vegetation consisted of a low Chenopod shrubland dominated by *Atriplex vesicaria*. Soil samples (n=10) were taken every two months from August 1985 (M2) to October 1986 (M16) to a depth of 25 cm. Nematodes were extracted from 50 ml of soil per sample.

The modified Baermann's funnel technique[3] was used to extract the different nematode trophic groups. After extraction (over a three day period), the nematodes were heat killed and fixed in 2% formalin (40% formaldehyde). The different trophic groups were then counted. The trophic groups consisted of:- omnivores (mainly dorylaims), bacterial feeders (mainly rhabditids), fungal feeders (mainly aphelenchs and tylenchs) and plant parasites (mainly *Tylenchorhynchus tobari* Sauer & Annells, 1981 and *Telotylenchus hastulatus* (Colbran, 1960) Siddiqi, 1963). The extraction efficiency was found to be about 65% and the counts were adjusted accordingly.

Anhydrobiotic ("coiled") and active ("straight") nematodes were extracted using the Hot Formalin method[4]. The method involved killing the nematodes in the soil with hot formalin (90°C), then separating the nematodes from the soil using a solution containing Separan NP - 10^R (Dow Chemical Ltd) (0.75g/l tap water). The nematodes were then separated into "coiled" and "straight" forms and counted. The extraction efficiency of the Hot Formalin method was found to be about 75% and the counts were adjusted accordingly. Due to loss of material it was not possible to extract nematodes from the August 1985 (M2) and February 1986 (M8) samples using the Hot Formalin method. The Hot Formalin method tended to extract more nematodes than the modified Baermann funnel technique possibly because the Hot Formalin method extracted directly from soil while the modified Baermann's funnel method relied on movement of nematodes into a collecting dish.

As with other arid regions[5], bacterial feeders were the most abundant trophic group found in the samples throughout the sampling period (Fig. 1). The other trophic groups occurred in much lower numbers. From August 1985 (M2) to April 1986 (M10) the total mean number of nematodes extracted was relatively constant, averaging around 200–300. Over the same period the mean number of "coiled" nematodes was much greater than "straight" nematodes (Fig. 2), fluctuating between 300 (M4) and 600 (M6) with the mean number of "straight" nematodes remaining fairly constant throughout.

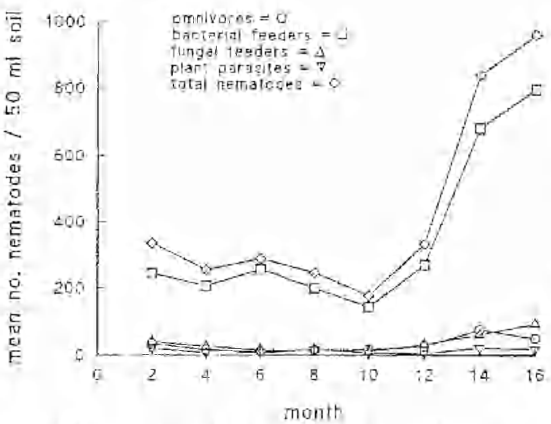

Fig. 1. Mean numbers of omnivores (○), bacterial feeders (□), fungal feeders (△), plant parasites (▽) and total nematodes (◇) extracted from 50 ml of soil (n=10) using the modified Baermann's funnel technique from samples collected every two months from August 1985 (2) to October 1986 (16).

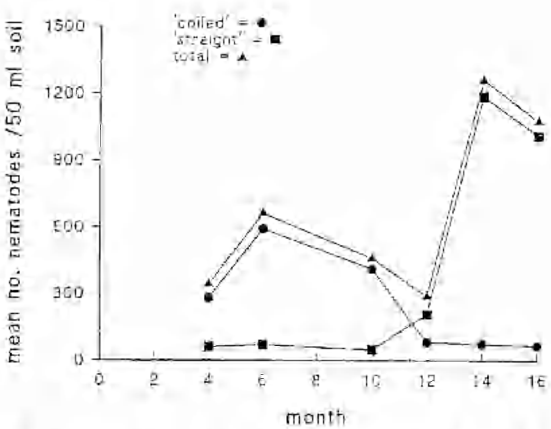

Fig. 2. Mean numbers of "coiled" (●), "straight" (■) and total nematodes (▲) extracted from 50 ml of soil (n=10) using the Hot Formalin method from samples collected every two months from October 1985 (4) to October 1986 (16) excluding February 1986 (8).

However, from June 1986 (M12) to October 1986 (M16) there was an increase in the mean number of all trophic groups (except plant parasites), with the bacterial feeders showing the greatest increase. During the same period there was also a large increase in the mean number of "straight" nematodes with a sharp decrease in numbers of "coiled" nematodes (M12) which remained fairly constant afterwards. The change in form of the nematodes was, therefore, closely correlated with the increase in numbers of nematodes, particularly the bacterial feeders. The change in form and increase in numbers of nematodes could reflect increased activity of the micro-flora within the soil ecosystem.

Rainfall may have been the trigger for the increased activity of the nematodes. The region under study usually has the highest rainfall and lowest temperatures during the months April to October and the driest and hottest months from November to March. Fig. 3 shows the rainfall recorded over the sample period at the homestead of Plumbago Station (about 10 km from the sample site). Over the first 10 months of sampling there were large fluctuations in rainfall while the final six months had a more even distribution. The final month had the highest rainfall of the sampling period. The more sustained period of rainfall over the last six months of sampling was matched with increased numbers of nematodes and increased numbers of "straight" or active nematodes.

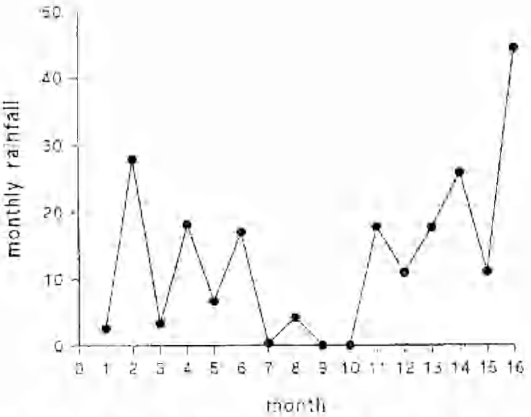

Fig. 3. Monthly rainfall (mm) recorded at Plumbago Station homestead from July 1985 (1) to October 1986 (16).

In other arid areas the activity of the nematodes was found to be exhibited as a "pulse" phenomenon[6], with an environmental "trigger" (i.e. rainfall) causing rapid increase in numbers followed by a rapid decrease when the soil dries out. The bacterial feeders were particularly well adapted to a cycle of dehydration and rehydration. The rapid response of the food source (bacteria) to appropriate environmental stimuli and the short life cycle of the nematodes (in some cases only 6-7 days) allows bacterial feeders to increase in numbers when conditions are favourable. In this study, the environmental "trigger" was found to be rainfall.

Nutrient turnover in soils of other arid regions were found to be influenced by nematodes as consumers of bacteria and yeast (during the first stages of decomposition) and fungi (as decomposition advanced)[7-9]. Further studies on the role of nematodes in nutrient turnover may be helpful when looking at the ecology of arid region soils and may be useful in assessing the impact of overgrazing and mining on soil ecology. Nematodes could be used to monitor levels of microbial activity within the soil as activity of nematodes can be measured through extraction of "coiled" and "straight" forms, which could reflect activity of the food source.

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